VAISALA

USER'S GUIDE

Vaisala HUMICAP® Humidity Transmitter Series HMP140A

U175EN15

PUBLISHED BY

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Contents

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1. PRODUCT DESCRIPTION

The HMP140A series transmitters are reliable and easy to use instruments for the measurement of relative humidity and temperature. The series consists of three different types of transmitters to be chosen according to the requirements of the application:

- HMP141A for wall installations
- HMP142A for duct installations
- HMP143A for installation in tight places

The configuration can be chosen from various possibilities to meet the specific requirements of the customer. The transmitters can be ordered with a blank cover or a cover with a local display which outputs relative humidity and temperature readings. The reading to be displayed is chosen with a pushbutton on the cover and the desired temperature unit (Celsius or Fahrenheit) can be chosen with a jumper (see Appendix 2).

All HMP140A transmitters measure relative humidity in the range of 0...100 %RH and temperature from -40 to +60 °C; the measurement is temperature compensated. The HMP140A transmitters have four different analogue outputs: 0...20 mA (4...20 mA), 0...1 V, 0...5 V and 0...10 V. The outputs are also scalable if necessary, e.g. 4...20 mA from 0...20 mA.

The durable plastic cover provides IP65 protection from dust and sprayed water. The HMP140A transmitters are therefore suitable for most indoor and outdoor applications, including those with high humidities like indoor swimming pools etc. These versatile transmitters are also easy to install and to use. When necessary, they can be recalibrated on site with Vaisala's HMI41 indicator equipped with an appropriate probe and optional calibration cable (19116ZZ).

The HMP140A series transmitters incorporate the HUMICAP®180 sensor, the operation of which is based on the changes in its capacitance as the thin polymer film absorbs water molecules. The sensor is immune to most chemicals and has an excellent long-term stability. The temperature is measured with a Pt 1000 sensor.

2. TO BE NOTED WHEN MEASURING HUMIDITY

In the measurement of humidity and especially in calibration, it is essential that the temperature equilibrium is reached. Even a slight difference in the temperature between the measured object and the sensor causes an error. For example, at +20 °C (+ 68 °F) and 50 %RH, a temperature difference of ±1 °C between the measured object and the sensor causes an error of ±3 %RH. If relative humidity is 90 %RH, the error is about ±5.4 %RH.

The error is at its greatest when the temperature of the sensor differs from that of the surroundings and the humidity is high. A few degrees' difference in temperature may cause water to condense on sensor surface. Efficient ventilation accelerates evaporation whereas in an unventilated space, it may take hours. The HUMICAP®180 sensor returns to its normal functioning as soon as water has evaporated. Any contaminated water condensing on the sensor may shorten its life span and change the calibration.

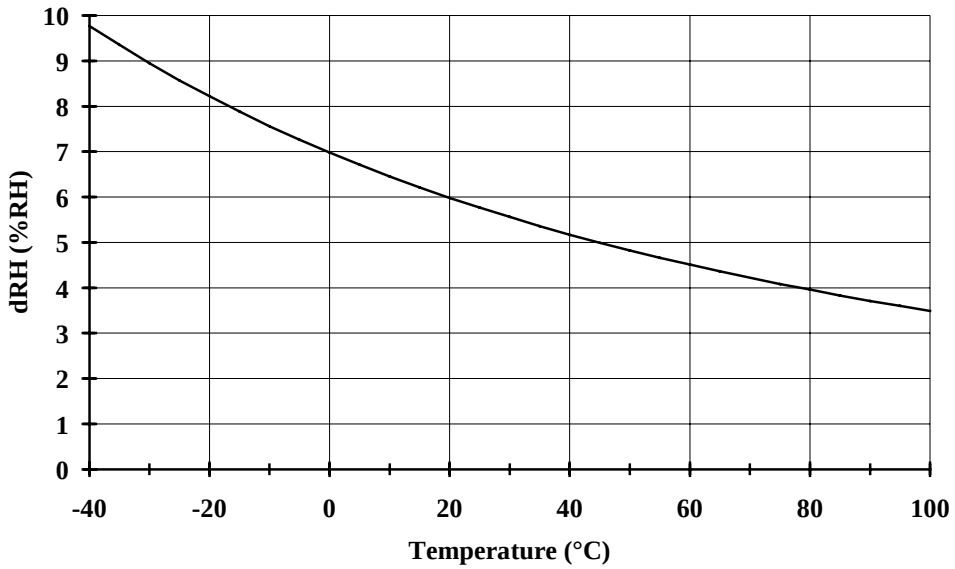


Figure 2.1 Measurement error at 100 %RH when the temperature difference between the ambient and the sensor is 1 °C

3. INSTALLATION

3.1 Selecting the place of installation

Select a place that gives a true picture of the environment or process and is as clean as possible. Air should circulate freely around the sensor. A rapid air flow is recommended as it ensures the same temperature for the ambient air and the sensor head.

Install the transmitter in a place where no cold or hot spot can develop. If the sensor head is installed in a duct or channel where the temperature is different from the ambient temperature, insulate the point of entry; this is particularly important if the transmitter is installed with the sensor head pointing downwards. Vertical installation of the HMP142A and HMP143A is not recommended; they should be mounted with the sensor head horizontally whenever possible. An uninsulated installation might lead to condensation on the sensor head and even if no condensation occurs, the resultant air flow may change the temperature near the sensor head and distort the readings.

3.2 Mounting

The electronics of the HMP140A series can be disconnected for ease of installation and service. The housing can be conveniently installed and the electronics then consequently mounted. For service and maintenance purposes the electronics can be disconnected without disconnecting the cabling, and taken to an appropriate environment for necessary adjustments.

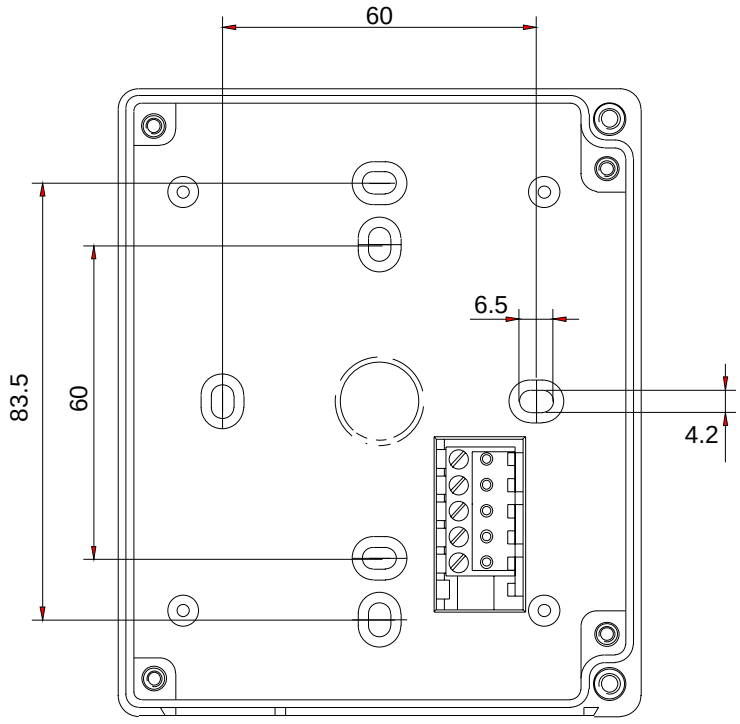


Figure 3 Drilling dimensions (in mm)

3.2.1 Mounting the HMP141A

The optimal installation of the HMP141A is with the sensor head pointing downwards. Upward mounting should be avoided due to internal heat transfer.

1. Mounting and wiring: cable feedthrough on the surface or in the connection box.
2. Mount the protection lid to the connection box.
3. Push the sensor head through the protection lid as in figure and connect the electronics housing to the connection box. Make sure that the pins at the bottom of the electronics housing are in contact with the screw terminal.
4. Fasten the four connecting screws of the electronics housing.
5. Place the sensor head into the protection lid.
6. Close the cover and fasten the two connection screws.

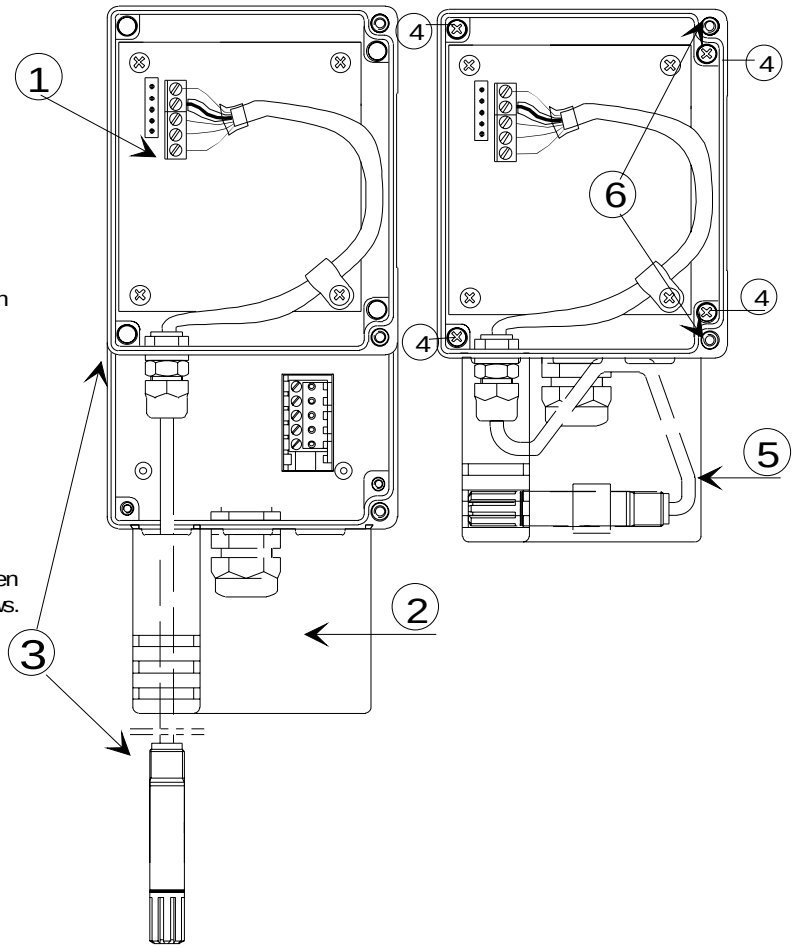


Figure 3.2.1 Mounting of the HMP141A

3.2.2 Mounting the HMP142A

The HMP142A transmitter should be mounted with the sensor head horizontally whenever possible. This way, any water that might condense on the tube cannot flow on to the sensors. When there is no alternative but to install the sensor head in the process vertically, the point of entry must be carefully insulated.

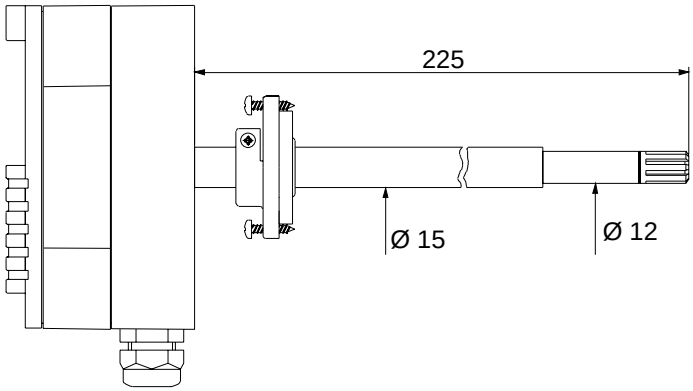


Figure 3.2.2 Dimensions of the HMP142A (in mm)

3.2.3 Mounting the HMP143A

The cable model HMP143A should also be mounted with the sensor head horizontally whenever possible. This model is provided with two plastic nuts and a gasket. Mount the nuts on the sensor head: disconnect the cable from the transmitter, insert the nuts and fasten them on the sensor head. Then reconnect the cable. A mounting flange is also available (see Fig. 3.2.3). The cable can also be extended up to 100 metres; see Appendix 3 for details.

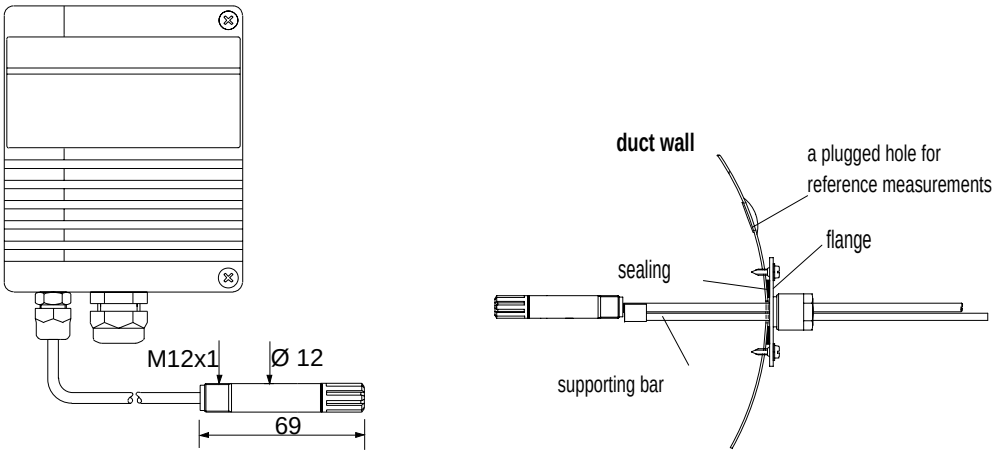


Figure 3.2.3 Dimensions of the HMP143A probe (in mm) and installation in a channel with the help of flange (part no. HMP233FA) and supporting bar

3.3 Electrical connections

The wiring can be done in either of the two ways shown in Figure 3.3.

mounting on a juction box **surface mount**

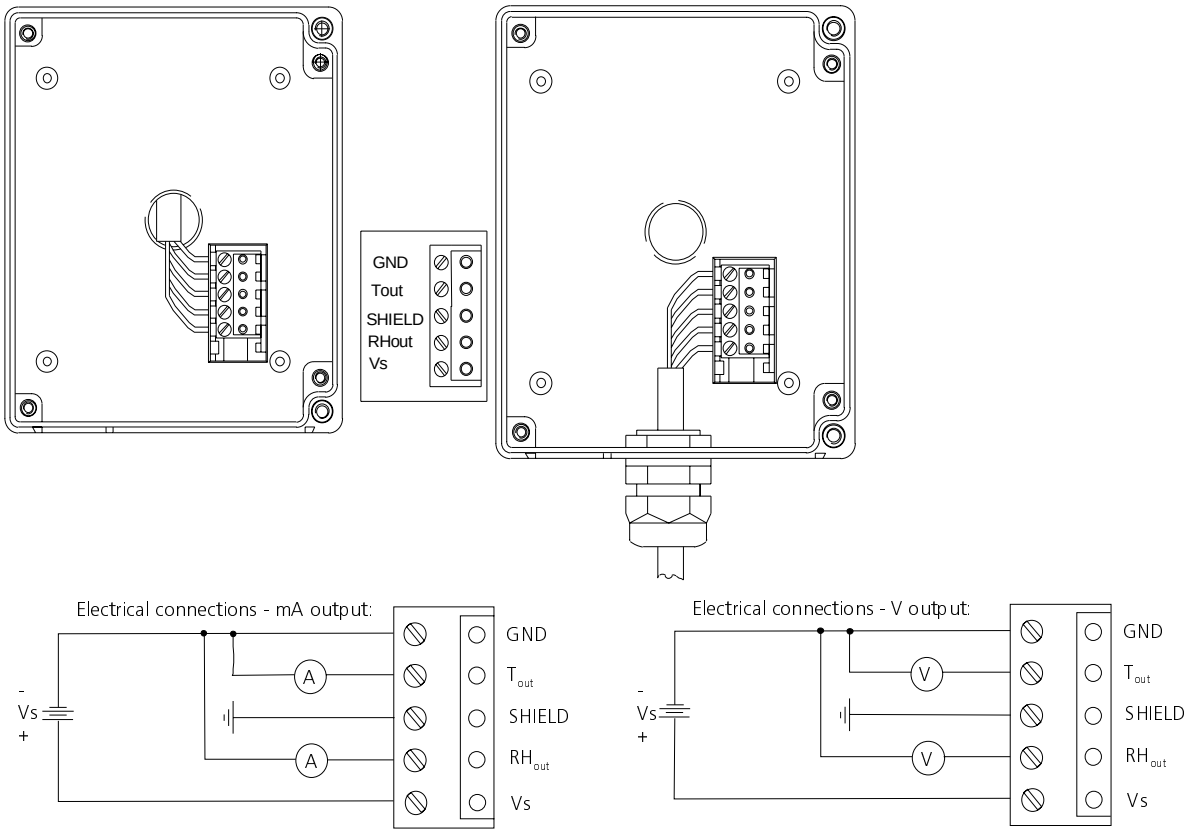


Figure 3.3 Electrical connections

Outputs		
0...20 mA (4...20 mA)	20...35 VDC	17...24 VAC
min.	$12 + \frac{R_L(ohm)}{50}$ VDC	
0...1 V	9...35 VDC	9...24 VAC
0...5 V	15...35 VDC	12...24 VAC
0...10 V	20...35 VDC	16...24 VAC

Current consumption	6...10 mA + output currents
Electrical connections	screw terminals for 0.5 - 1.5 mm^2 wires (AWG 15...20), stranded wires recommended

3.4 Connectors and potentiometers on the main PCB

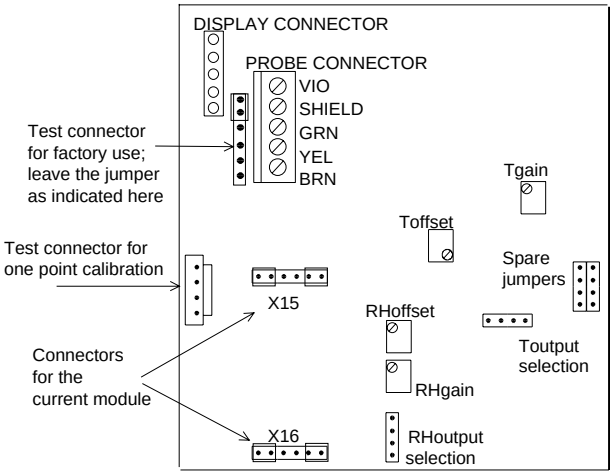


Figure 3.4 Connectors and potentiometers on the main PCB

3.5 Selecting the outputs

The HMP140A series transmitters can be ordered with the desired output signals already selected. If the outputs are changed, the jumpers have to be moved to corresponding places (see Figure 3.5). For current outputs, see Appendix 1. Jumper changes may change the output < ±0.15 %FS within the chosen range; this usually does not give cause to recalibration.

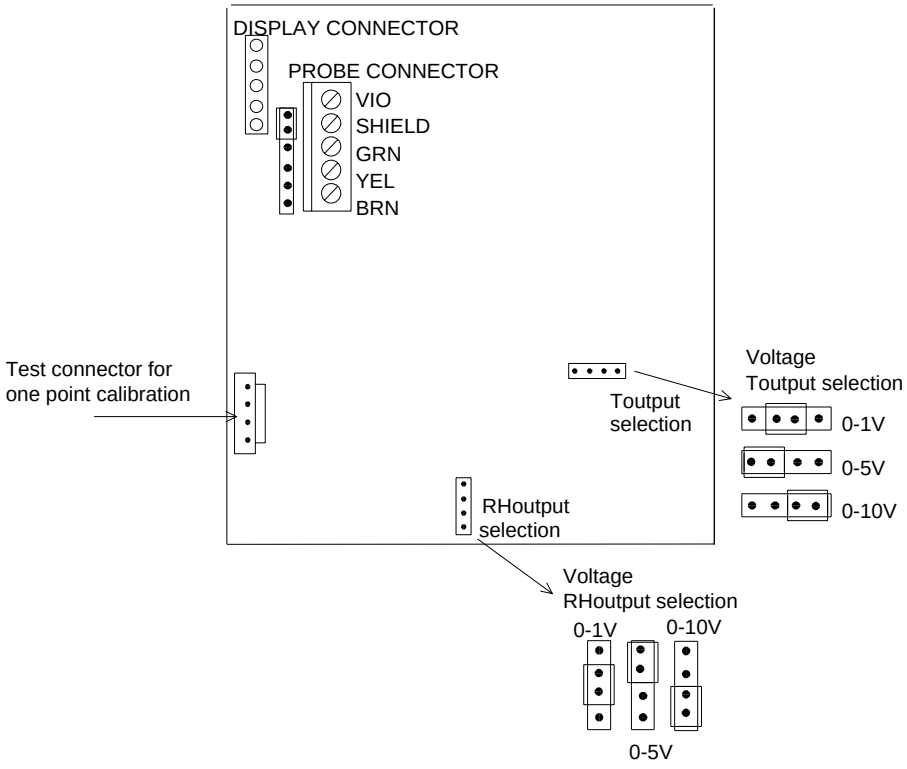


Figure 3.5 Jumper positions for voltage outputs

3.6 Connection to an AC supply

The HMP140A transmitters can also be connected to an AC supply without an external rectifier. However, when two or more transmitters are connected to one 24 VAC transformer, a common loop is formed and there is an increased risk of a short-circuit. To avoid this, always use separate floating supply for each transmitter (see Figure 3.6 A). However, if several transmitters have to share one transformer, always connect the phase (~) to + connector in each transmitter (see Figure 3.6 B).

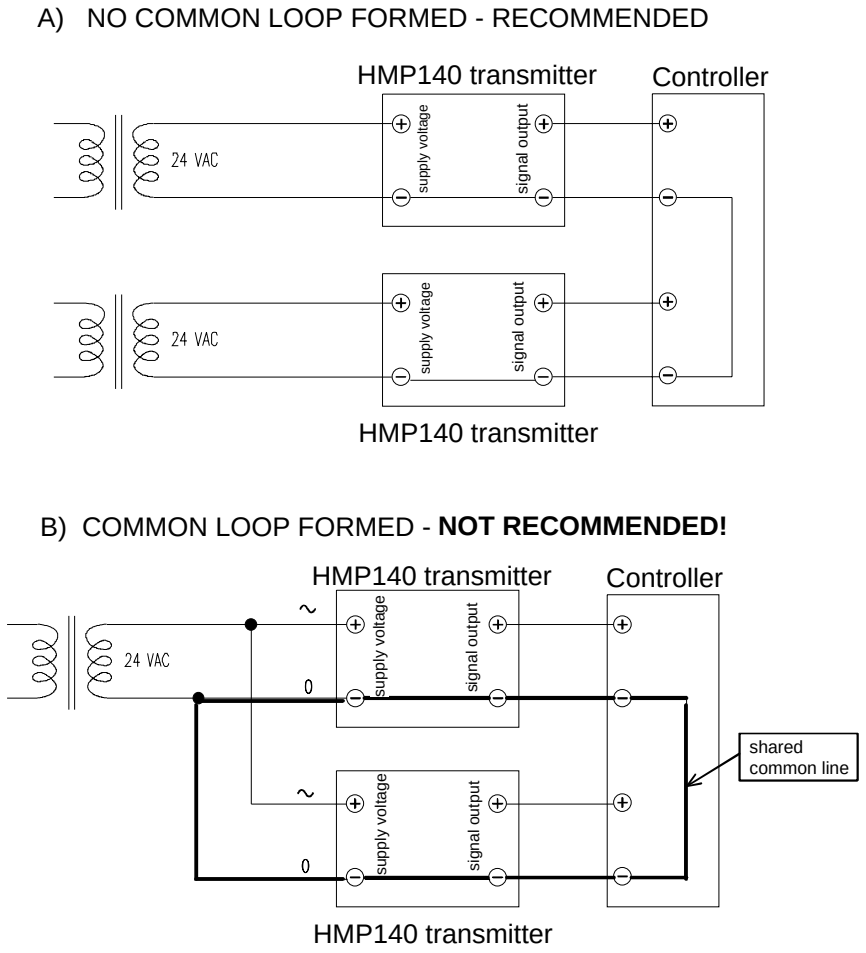


Figure 3.6 Connecting the transmitters to a 24 VAC supply

4. CALIBRATION

4.1 One-point humidity calibration

The HMP140A series transmitters should be recalibrated approximately once a year. The interval depends on the operating conditions and the required accuracy. One-point calibration can be done with Vaisala's portable HMI41 indicator equipped with an appropriate probe and optional calibration cable (19116ZZ). The cable is connected to a test connector either on the main component board of the HMP140A or, if a current output module is installed, on the module (see Figure 4.1). For more detailed instructions, see the operating manual of the calibration cable (U218en).

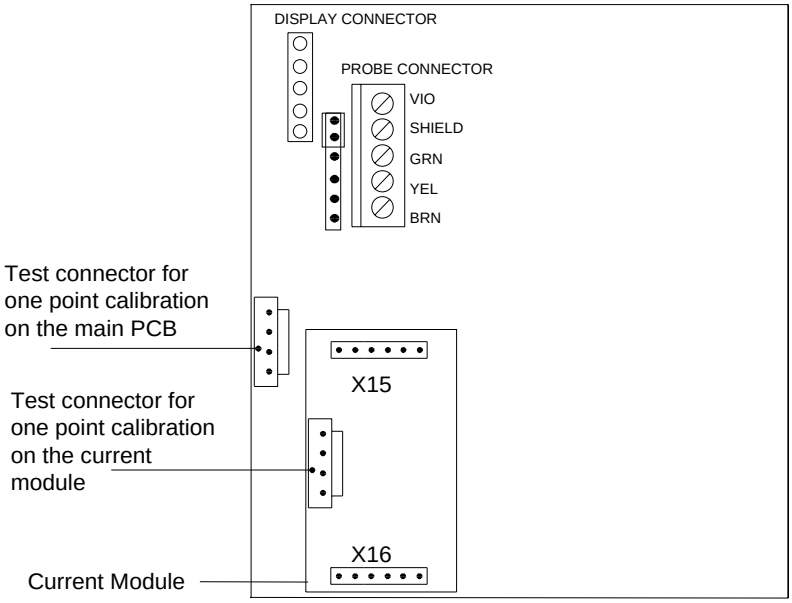


Figure 4.1 Location of the test connectors

4.2 Two-point humidity calibration

The calibration can also be done with the HMK11 or the HMK13B Calibrator, or the instrument can be sent to Vaisala or a Vaisala representative.

4.2.1 Two-point humidity calibration procedure

- Leave the calibrator and the transmitter for at least 30 minutes in the same space so that their temperatures have time to equalize.
- Place the probe into the calibration hole of the LiCl bottle in the humidity calibrator.
- Wait for 10 minutes.

- Use the RH offset potentiometer (see Figure 4.2) to adjust the output signal to the value given in the calibration table (Chapter 4.4).
- Place the probe into the calibration hole of the NaCl bottle in the calibrator.
- Wait for 10 minutes.
- Check that the reading corresponds within the desired accuracy to the reading given in the calibration table. If not, adjust the reading with the RH gain potentiometer (see Figure 4.2).
- Check again the reading at the first point and adjust if necessary.

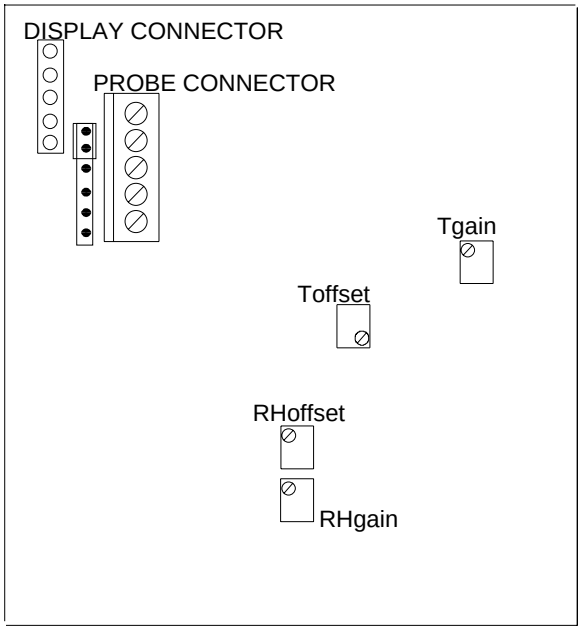


Figure 4.2 Calibration potentiometers

4.3 Temperature calibration

One point temperature calibration can be performed with the HMI41 equipped with an appropriate probe and optional calibration cable if the accuracy of ±0.5 °C is sufficient. For further details, see the operating manual of the HMI41 and calibration option.

4.4 Calibration table

Temperature	°C	15	20	25	30	35
	°F	59	68	77	86	95
LiCl	%RH	*)	11.3	11.3	11.3	11.3
4...20 mA	mA		5.81	5.81	5.81	5.81
0...20 mA	mA		2.26	2.26	2.26	2.26
0...1 V	V		0.113	0.113	0.113	0.113
0...5 V	V		0.565	0.565	0.565	0.565
0...10 V	V		1.13	1.13	1.13	1.13
NaCl	%RH	75.6	75.5	75.3	75.1	74.9
4...20 mA	mA	16.10	16.08	16.05	16.02	15.98
0...20 mA	mA	15.12	15.10	15.06	15.02	14.98
0...1 V	V	0.756	0.755	0.753	0.751	0.749
0...5 V	V	3.780	3.775	3.765	3.755	3.745
0...10 V	V	7.56	7.55	7.53	7.51	7.49

*) LiCl solution must not be used or stored in temperatures below +18 °C (+64 °F); otherwise the equilibrium humidity of the salt solution changes permanently

Table 1 Greenspan's calibration table with output values according to the chosen scale

5. MAINTENANCE

5.1 Replacing the HUMICAP®180 sensor and the filter

Remove the damaged sensor and insert a new one. Handle the sensor by the plastic socket. DO NOT TOUCH THE SENSOR PLATE. Check the output after sensor change. If it deviates too much from the reference value, recalibrate the transmitter. Note that even after sensor change, the accuracy is still $\pm$7 %RH.

Replace a dirty filter to ensure a maximum lifetime for the sensor. Do not try to clean the filter. The sensor can be cleaned with distilled water; if this does not help, replace the sensor. Do not use any mechanical methods.

6. TECHNICAL DATA

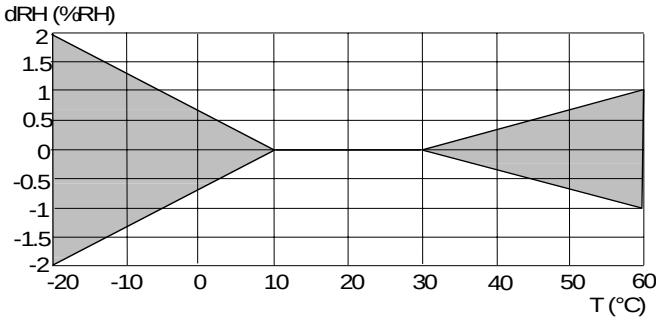
6.1 Relative humidity

Measurement range 0...100 %RH

Accuracy (including non-linearity and repeatibility)
when calibrated against salt solutions (ASTM E104-85):

0...90 %RH	±2 %RH
90...100 %RH	±3 %RH

Temperature dependence:



Response time (90%) 15 s at +20 °C in still air (with sintered filter)

Maximum error between
the display and the outputs 0.2 %RH

Humidity sensor HUMICAP®180

6.2 Temperature

Measurement range -20...+60 °C

Typical accuracy at:

+20 °C	±0.2 °C
-10...+40 °C	±0.3 °C
-20...+60 °C	±0.4 °C

Temperature sensor Pt 1000 IEC 751 Class B

6.3 General

Power supply		
current outputs:	20...35 VDC	17...24 VAC
min.	$12 + \frac{R_L \text{ (ohm)}}{50}$	
0...1 V	9...35 VDC	9...24 VAC
0...5 V	15...35 VDC	12...24 VAC
0...10 V	20...35 VDC	16...24 VAC

Current consumption 6...10 mA + output currents

Electrical connections screw terminals for 0.5 - 1.5 mm^2 wires (AWG 15...20), stranded wires recommended

Alternative analogue
output signals (scalable) 0...20 mA (4...20 mA)
0...1 V, 0...5 V, 0...10 V

NOTE! Output scales correspond to 0…100 %RH and -40…+60°C.

External loads for	
current outputs	$\leq$ 500 Ω
0...1 V	$\geq$ 1 kΩ (to ground)
0...5 V	$\geq$ 5 kΩ (to ground)
0...10 V	$\geq$10 kΩ (to ground)

Operating temperature range

for electronics	-20...+60 °C
with display option	0...+50 °C

Storage temperature range -40...+80 °C

Operating humidity range 0...100 %RH

Bushing for ∅ 7...10 mm cables

Sensor protection

standard	membrane filter, part no. 17039HM
option	plastic grid, part no. 17038

Cable length of HMP143A

standard	2.5 m
maximum	100 m (user extendable, see Appendix 3)

Housing material ABS plastic

Housing classification IP65 (NEMA 4)

6.4 Electromagnetic compatibility

6.4.1 Emissions

Test:	Setup according to:	
Radiated interference	EN55022	(class B)

6.4.2 Interference

Test:	Setup according to:	Performance:
Electrostatic discharge	IEC 801-2	criteria B
RF-radiated fields (allowed temporary effect ±1 °C in temperature)	IEC 801-3	criteria A
Electrical fast transients	IEC 801-4	criteria B

CE

7. SPARE PARTS AND ACCESSORIES

Order code	Description
HMP233FA	mounting flange for the HMP143A
19326	junction box for the HMP143A cable extension (seeApp.3)
1535	extension cable for the HMP143A (see Appendix 3)
17039HM	membrane filter
17038	plastic grid
HUMICAP®180	humidity sensor

GUARANTEE

Vaisala issues a guarantee for the material and workmanship of this product under normal operating conditions for one (1) year from the date of delivery.

Exceptional operating conditions, damage due to careless handling and misapplication will void the guarantee.

APPENDIX 1: CURRENT OUTPUT MODULE

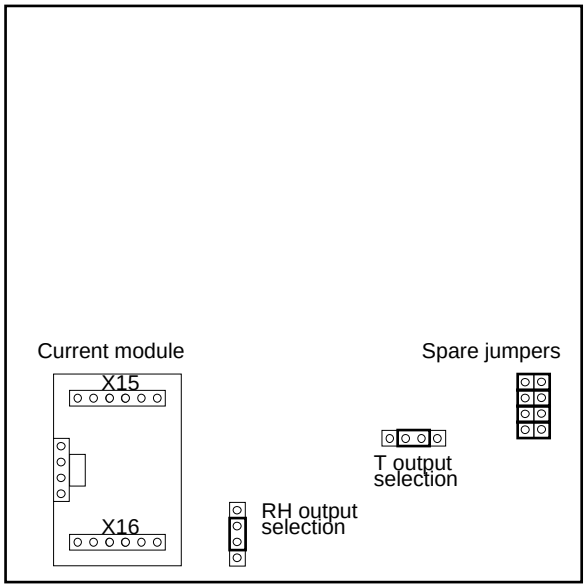


Figure 1

The current module is available only for HMP142A and HMP143A transmitters. To install the current module to connectors X15 and X16, first disconnect the jumpers (4 pcs). Insert them to the connector for spare jumpers (see Figure 1) and install the current module. Note that the module must be installed exactly as indicated in Figure 1. The jumpers for RH and T output selections must be connected in two middle pins of the connectors (Figure 1). Recalibrate the transmitter after having installed the current module. The maximum error in output without recalibration is ± 0.5 %FS.

APPENDIX 2: SETTINGS OF THE LOCAL DISPLAY

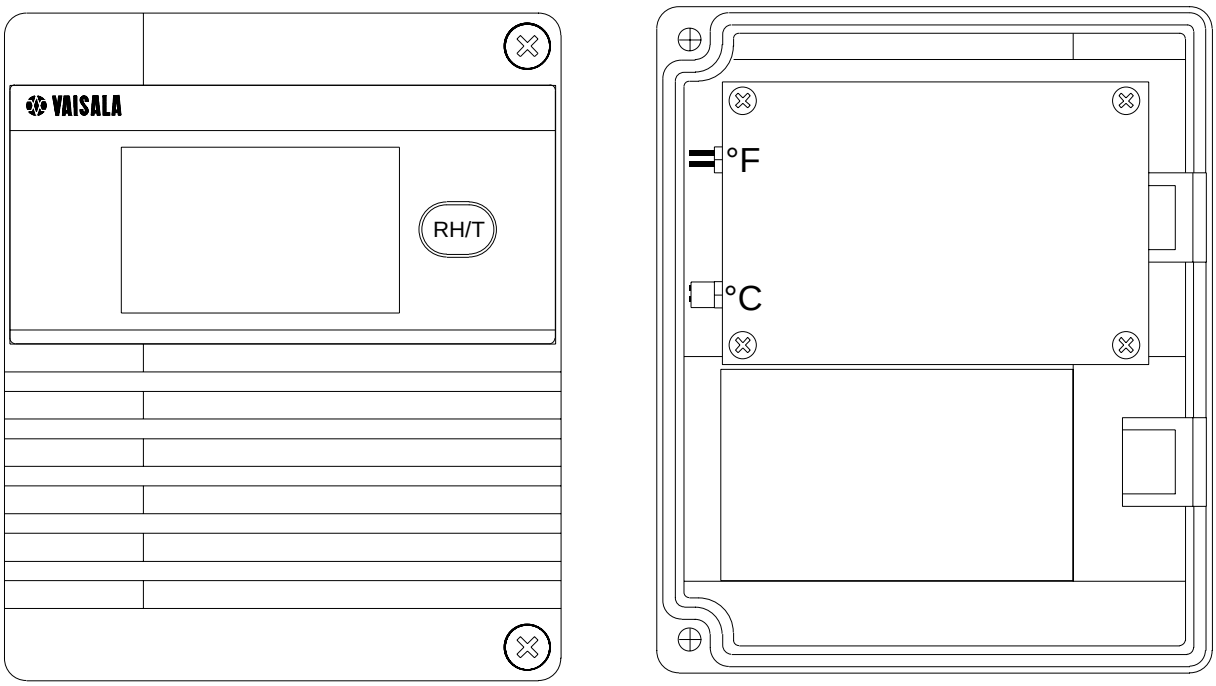


Figure 1 Location of the RH/T button and the °C/°F jumpers

The reading on the local display (relative humidity or temperature) can be chosen by pressing the RH/T button beside the display. At power-up, the display always shows the relative humidity reading. This can be changed to temperature reading by pressing the RH/T button once. Further pressings will change the reading between RH and T.

The temperature unit (°Celsius or °Fahrenheit) is chosen with the jumper on back of the local display unit. For °C, the jumper is connected to the lower position and for °F, it is connected to the upper position (see Figure 1).

NOTE!

The HMP140A series transmitters with the local display and current output cannot be re-scaled.

APPENDIX 3: HMP143A PROBE CABLE EXTENSION

The cable of the HMP143A probe can be extended up to 100 metres with the help of the extension set including a junction box (part no. 19326) and a shielded six wire extension cable (part no. 1535).

The junction box has a 5-pole terminal block and two PG9 lead-throughs. The extension cable is a shielded 6 x 0.22 mm^2 copper wire cable. This cable enables the extension without the need for transmitter adjustments. The user can also use some other cable for this purpose provided that it is a shielded copper wire cable. A shielded cable is recommended as it ensures the best possible EMC protection. The diameter of the cable should not exceed 7 mm as larger cables do not fit to the lead-through of the transmitter.

The HMP143A probe head uses a combined signal ground and supply voltage ground. Ground wire resistance R_C causes an offset type error to the transmitter output. The error is **$-0.11 \times R_C$** both in %RH and in °C. This means that if maximum error allowed is e.g. -0.3 %RH or -0.3 °C, the ground wire resistance should not exceed 2.7Ω. The resistance of the cable 1535 is minimized by connecting three wires as a ground conductor (see Figure 1). Possible error can also be leveled out by readjusting the transmitter offset (RH offset and T offset).

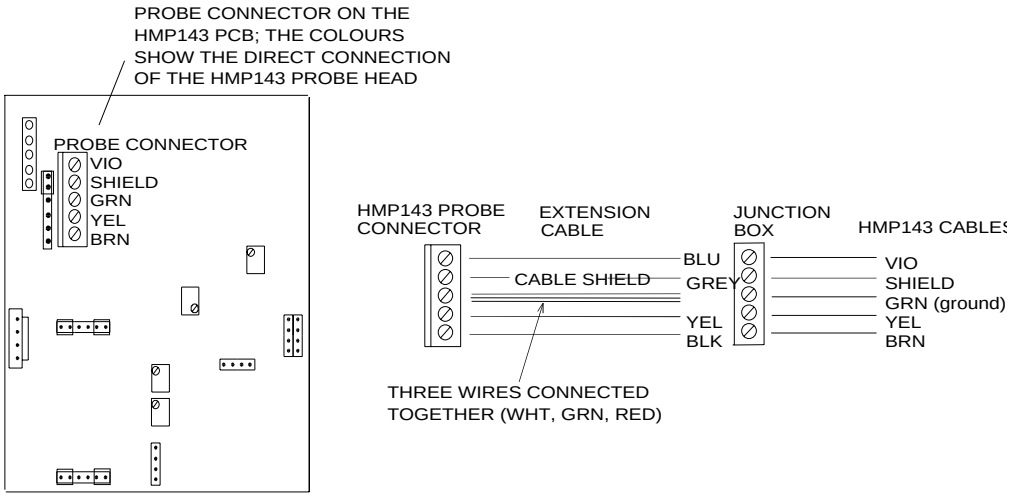


Figure 1 Schematic of the extension set connections

TECHNICAL DATA

Junction box (part no. 19326)

Housing:	
material	ABS plastic
dimensions	65 x 50 x 35 mm (l x w x h)
classification	IP 65
temperature range	-40...+80 °C
Lead-throughs:	
size	PG 9
cable diameter	4...7 mm
housing classification	IP 68
Terminal block:	
max. wire area	1.5 mm^2

Extension cable (part no. 1535)

Type	PFSK 6 x 0.22 mm^2
Wire resistance	80 Ω / km
Covering	braided, tinned copper wire
Cross-sectional area of the wires	0.22 mm^2
Cover	PVC, light grey
Temperature range	-30...+70 °C
Wire colours	red, blue, green, yellow, white, black (DEF-STAN 61-12)

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